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(71) Applicant *(for all designated States except US)*: **SHELL OIL COMPANY** [US/US]; One Shell Plaza, 47th Floor, P.O. Box 2463, Houston, TX 77252-2463 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **PADULA, Joseph, A.** [CA/CA]; 23625 Del Monte Drive, #313, Valencia, CA 91355 (US). **MELLO, Jeffrey, A.** [US/US]; 1062 Wilson Drive, Simi Valley, CA 93065 (US).

(74) Agent: **CHRISTENSEN, Del, S.**: Shell Oil Company, One Shell Plaza, 47th floor, P.O. Box 2463, Houston, TX 77252-2463 (US).

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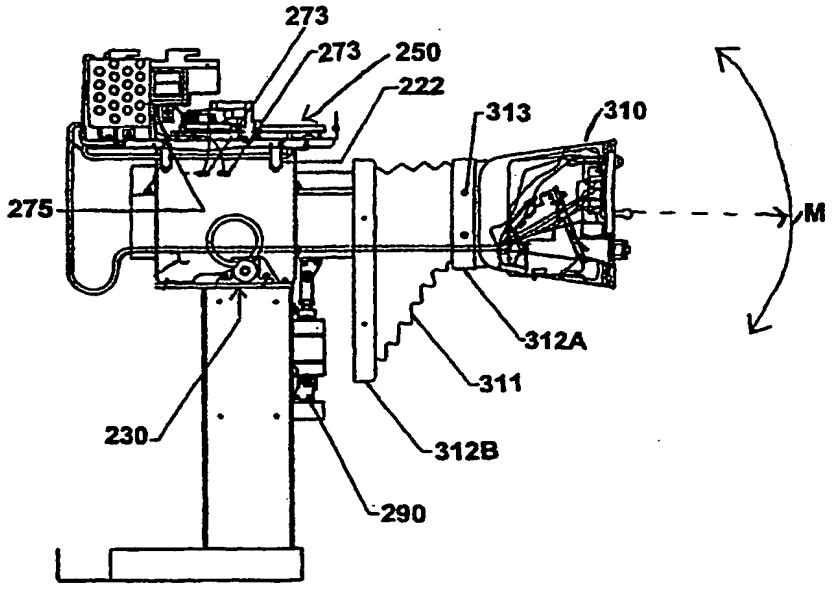

(57) Abstract: The present invention provides a customer interface with a console that may be both laterally and radially positioned for a vehicle driver. In one embodiment, the customer interface includes a horizontal extender, a vertical extender, and a console. The horizontal extender has a first end and a controllably extendable second end, and the horizontal extender is pivotable at its first end. The console is mounted to the controllably extendable second end. The vertical extender is operably mounted to the horizontal extender between its first and second ends for vertically adjusting the horizontal extender. Thus, the console is laterally extendable and radially positionable from its first end. In this manner, the console may be radially positioned and laterally extended in front of the driver.

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CUSTOMER INTERFACE FOR ORDERS AND PAYMENTS

Technical Field of the Invention

The present invention relates generally to the field of customer interfaces. In particular, the present invention relates to a customer interface for an automatic refueling system.

Background of the Invention

Numerous apparatuses have been proposed and used for customer interfaces where the customer is sitting in a motor vehicle. For example, drive-in bank tellers have been common for many decades. These drive-in teller booths have been often replaced with automatic teller machines to which a driver may pull-up and transact business through the driver side window of a vehicle. These apparatuses are placed at a height that can be reached by the majority of the vehicles on

the road, but this height is generally either too high or too low for any particular vehicle. It is not uncommon for the driver to have to exit the vehicle to utilize such an interface, thus defeating much of the advantage of a customer interface that is intended to be accessed from a vehicle.

Stationary arrangements for customer interfaces are disclosed in, for example, U.S. Pat. Nos. 5,027,282 and 4,881,581.

German Patent Application DE 42 42 243 A1 discloses a customer interface for an automated refueling apparatus that is movable in one direction. Movement is desired in this apparatus because the vehicle is spotted by placing a front tire into a grove, and because the

distance from the front tire to the driver's window can vary considerably between vehicles. The customer interface remains at a fixed height, and is not moved toward the vehicle at all. Besides for customer convenience and comfort, it would be particularly desirable to provide an interface that can be consistently accessed without having to open the driver's door because it would be desirable in an automated refueling system to have an intruder interruption wherein if a person is detected outside of the vehicle, the automated refueling is interrupted. It would be unacceptable for such an interruption to result if it were necessary to open the driver's door to access the customer interface.

Further, fixed customer interfaces can only be as close to the vehicle as the driver is capable of pulling up to the interface. A curb is typically provided to prevent a driver from scraping a protruding review mirror on the interface, resulting in a significant lateral distance between the interface and the driver.

A "customer interface" as referred to herein is meant to comprise a console (or panel) that is intended to be interfaced with a person sitting in a motor vehicle. Such a console may include, individually or in combination, speakers, microphones, visual displays, card readers, push buttons, shutdown switches, and the like.

U.S. Pat. No. 5,644,119 to Padula eta al. discloses a customer interface for a customer seated in a vehicle wherein an interface console is moved laterally toward a driver's window of the vehicle and vertically to an appropriate height. Unfortunately, with this design, a substantial portion of the electronics are located for the most part in the customer console. The customer console is thus relatively heavy and, as a result, the console can only be moved straight vertically up and down and straight horizontally toward and away from the driver. This limits the positioning capability of the console with respect to the driver.

Accordingly, what is desired is an improved customer interface with a more flexibly positionable console for positioning in front of a driver.

Summary of the Invention

The present invention provides a customer interface with a console that may be both laterally and radially positioned in front of a vehicle driver. In one embodiment, the customer interface includes a horizontal extender, a vertical extender, and a console. The horizontal extender has a first end and a controllably extendable second end, and the horizontal extender is pivotable at its first end.

The console is mounted to the controllably extendable second end. The vertical extender is operably mounted to the horizontal extender between its first and second ends for vertically adjusting the horizontal extender. Thus, the console is laterally extendable and radially positionable from its first end. In this manner, the console may be radially positioned and laterally extended in front of the driver.

The foregoing has outlined rather broadly the features and technical advantages of the present invention in order that the detailed description of the invention that follows may be better understood. Additional features and advantages of the invention will be described hereinafter which form the subject of the claims of the invention. It should be appreciated by those skilled in the art that the conception and specific embodiment disclosed may be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes of the present invention. It should also be realized by those skilled in the art that such equivalent constructions do not depart from the spirit and scope of the invention as set forth in the appended claims.

Brief Description of the Drawings

For a more complete understanding of the present invention, and the advantages thereof, reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which:

Figure 1 shows a prior art refueling system of the type that may be used in connection with the improved customer interface of the present invention.

Figure 2 shows one embodiment of a customer interface of the present invention with a vehicle in an operable position.

Figure 3A shows an isolated view of the customer interface of Figure 2.

Figure 3B shows a rear view of the customer interface of Figure 3A.

Figure 4A shows a front view of a horizontal extender of the present invention.

Figure 4B shows a side sectional view taken along lines 4B-4B of the horizontal extender of Figure 4A.

Figure 5A shows a front view of a pivot assembly of the present invention.

Figure 5B shows a top view of the pivot assembly of Figure 5A.

Figure 5C shows an end view of the pivot assembly of Figure 5A taken along lines 4C-4C.

Figure 6A shows a front view of a vertical extender of the present invention.

Figure 6B shows a side view of the vertical extender of Figure 6A.

Figure 7 schematically depicts one embodiment of a pneumatic system of the present invention.

Figure 8 shows a block diagram of a control system for the customer interface of the present invention.

Detailed Description of the Preferred Embodiments

Figure 1shows a prior art refueling system 100 from U.S. Pat. No. 5,644,119, which is commonly owned by the assignee of and hereby incorporated by reference into this specification. The improved customer interface of the present invention may be utilized with any suitable refueling system such as system 100. Refueling system 100 generally includes an overhead gantry 101 with a set of longitudinal supports 102 and a cross member 103, as shown in Figure 1. This gantry can move a nozzle manipulator 105 to position the refueling nozzle on either side, or the rear of a vehicle 107, according to the location of the fuel inlet.

The location of the fuel inlet can be determined from data obtained from a transponder card (or other suitable means) placed, e.g., on a windshield of a vehicle to be refueled 107. The transponder card can be one of many commercially available, preferably passive, transponder systems. For example, Amtech, located in Dallas, Texas, offers a transponder card system called "INTELLATAG". They have a data capacity of 1408 bits, and operate on a radio frequency of 924 Mhz. Motorola Indala, of San Jose, Calif., produces a system of having a 64 bit capacity that is readable from about two feet. Active transponders are also available that operate on watch-type batteries and have significantly greater range. Although active transponders are more expensive, they could be acceptable in the practice of the present invention. Other means of determining the vehicle type and/or identification could be utilized other than a transponder. For example, an optical bar code could be provided on a sticker on a window, bumper or fender. Magnetic strips could also be provided to transmit this information, but the range from which a magnetic strip could be read is limited. The transponder system provides vehicle information to the automated refueling system thereby allowing the system to determine the location of the fuel inlet on the vehicle.

A customer interface 108 is provided that optionally includes a credit card reader (not shown). Use of the customer interface and credit card reader ensures that the refueling operation is intentionally initiated by the customer and provides a confirmation that the authorized customer is receiving the refueling service.

Positioning of the fuel supply nozzle adjacent to the fuel inlet may be accomplished by a position sensor located on the fuel supply nozzle. The position sensor determines the position of the fuel supply nozzle with relationship to the fuel supply inlet. This position sensor may be, for example, a magnetic flux determination, with a magnet located on either the fuel inlet, fuel cap or on the hinged lid over the fuel inlet, or a vision system with a visual pick-up located on the fuel supply nozzle with information from the visual pick-up processed by software capable of recognizing the outline of the fuel hinged cover or fuel cap, and most preferably, also the position of the hinged cover about its hinged axis.

If a vision system is utilized to identify the position of the fuel inlet, the vision system may also be used to identify the location of the fuel cap after the hinged cover is opened, and possibly to identify the license plate number of the vehicle, for example, as a security check.

A simple range determination can alternatively be provided to determine the location of the vehicle relative to the customer interface. A preferred range determination is by an ultrasonic range finding system, which is available from Polaroid. Such an ultrasonic system can be provided to confirm that movement of the customer interface will not cause a collision with the vehicle.

Range finding sensors of the present invention could be, rather than ultrasonic, for example, radar or laser. Ultrasonic systems are presently preferred because they have acceptable sensitivity and are less expensive than currently available alternatives. An

acceptable radar based range finding sensor has been recently developed by Lawrence Livermore Laboratories, and has been referred to as a micropower impulse radar, or MIR. This technology has been incorporated in commercial products and is both inexpensive and accurate.

The range finding sensor used to determine the lateral distance which the customer interface will be moved can also determine if a side mirror or other part of the vehicle is in the way of the desired path of the customer interface. Such a range finding sensor would also prevent the customer interface from bumping a part of the driver, such as the driver's arm, extending out of the window of the vehicle.

The means to determine the position of the vehicle relative to the automated refueling system may be, for example, a probe extended to an expected location of a tire, a series of pressure sensors under or in the surface on which the vehicle is located, a series of ultrasonic, radar, laser ranger finders or a vision system. The vision system is shown with a camera 110 positioned above the expected location of the vehicle looking down at the vehicle. The camera produces an image that is digitalized and communicated to a central processing unit that can be a programmable logic controller or a computer. The central processing unit can determine from the data provided by the camera the location of the vehicle within the view of the camera. A vision system could also verify that the shape and, if a color camera is utilized, if the color of the vehicle matches the vehicle for which the transponder card is issued.

Automated refueling will require that measures be taken to prevent overfilling of fuel tanks by the automated refueling systems.

With reference to Figures 2, 3A, and 3B, a customer interface 200 according to one embodiment of the present invention is shown. In the depicted embodiment, customer interface 200 comprises kickplate 205, base 210, system control assemblies 220 and 225, pivot assembly 230, horizontal extender 250, vertical extender 290, and console assembly 310. the base 210 is fixed to kickplate 205, which is anchored to the ground. The horizontal extender 250, which has fixed and extendable portions, is pivotally mounted at its fixed portion to base 210 through pivot assembly 230. Console 310 is operably mounted at the extendable portion of the horizontal extender 250. System control assembly 220 is mounted within base 210; while system control assembly 225 is mounted rearwardly at the fixed portion of the horizontal extender 250. The vertical extender also has fixed and extending portions. At its fixed end, the vertical extender 290 is pivotally mounted to the base 210; and at its extending end, the vertical extender 290 is pivotally mounted to the horizontal extender 250. In this manner, vertical extender 290 and horizontal extender 250 in cooperation with one another may be operated to radially move console 310, as is shown at M in Figure 3A.

Also included in the depicted embodiments are bellows 311. Bellows 311 are fastened between console 310 and horizontal extender 250 with bellow retainers 312A and 312B and batchee fastener 313.

In the depicted embodiment, the horizontal and vertical actuators are implemented with pneumatic actuators. Accordingly, the customer interface includes pneumatic tubing operably mounted to the extenders as part of a pneumatic system 400 (not shown), which will be discussed in greater detail below. Also shown are control cables 221 mounted (e.g., with cable mounts 222) between system control assemblies 220, 225 and the horizontal and vertical extenders 250, 290. As will be discussed below, a control system 515 (not shown) for

controlling customer interface 200 (as well as possibly the overall refueling system 100) is implemented within system control assemblies 220 and 225.

The customer console 310 may be any suitable device or assembly for receiving from and conveying information to a vehicle driver in order to effectuate the automatic refueling process. In one embodiment, the console 310 comprises a display (e.g. monitor, LCD panel), key pad, a card reader, various buttons, a printer and receipt cutter, speaker, thermostat, and an emergency halt switch.

Figures 3A and 3B show the horizontal extender 250 in isolation, along with the pivot assembly 230. The horizontal extender generally comprises pneumatic actuator 252 controllably and movably mounted to extension arm assembly 254.

In the depicted embodiment, the pneumatic actuator is a PFC-1718-XP position feedback actuator available from Bimba Mfg. Co. of Monee, Illinois. This particular pneumatic actuator has an 18" stroke. However, any suitable actuator device for controllably extending and retracting the extension arm assembly 254 could be used. Suitable actuators could include but are not limited to hydraulic and electro-mechanical devices. The pneumatic actuator 252 has pivot brackets 271 and rod clevis 272 for mounting to the extension arm assembly 254. In addition, actuator 252 has position feedback sensors 273 for providing a signal whose value is indicative of the length of actuator extension. In the depicted embodiment, the sensors are part of a continuous position feedback device.

The depicted extension arm assembly 254 comprises beam 256, inner telescopic beam assembly 257, linear slide assembly 259, outer reinforcing plate 260, inner reinforcing plate 261, swivel elbow 263, plug connector 265, spacer plate 267, and pivot bracket 269. The inner telescopic beam assembly 257, which comprises extendable first and second sections

257A and 257B, is mounted within beam 256. The linear slide assembly 259 also has extendable first and second sections 259A and 259B. These sections are correspondingly mounted to the first and second inner telescopic beam sections 257A and 257B, respectively. Outer and inner reinforcing plates 260 and 261, respectively, are mounted as shown to operably secure the telescopic beam assembly 257 to the linear slide assembly 259.

The pivot bracket 269 is mounted through spacer plate 267 to the underside of the first (extendable) section 257A of the telescopic beam 257. The pivot bracket 269 is used to pivotally connect the horizontal extender 250 to the vertical extender 290. In turn, the pivot assembly 230 (which will be more particularly addressed below) is mounted to the underside of the second telescopic beam section 257B. With this configuration, the second beam section 257B would be fixed relative to the base 210; while the first beam section, which would mount to console 310, is controllably extendable and retractable with respect to the base 210.

Figures 5A through 5C show an embodiment of pivot assembly 230. Pivot assembly 230 generally includes pillow blocks 232, shaft 234, and clamping block 236. The pillow blocks support shaft 234, which is rotatably mounted there between. The clamping block 236 is mounted between the pillow blocks 232. The pillow blocks also include lubrication port 238 for lubricating shaft 234. The horizontal extender is pivotally mounted about the shaft 234, which allows it to pivot upwardly and downwardly with respect to the ground. In turn, the underside of the pillow blocks 232 and clamping block 236 are fixed to an upper side of the base 210. Figures 6A and 6B show vertical extender 290. In the depicted embodiment, vertical extender 290 is implemented with a pneumatic actuator 292. The depicted pneumatic actuator is a 1.25" stroke, three-phase 701.25-DXPN Bimba actuator, available from Bimba Mfg. Co. of Monee, Illinois. Again, however, any suitable actuator could be used such as a

hydraulic or electro-mechanical device. Pneumatic actuator 292 also includes rod clevis 294 and pivot bracket 296. The rod clevis 294 pivotally mounts to the pivot bracket 269 of the horizontal extender 250. The pivot bracket 296, which is pivotally connected to pneumatic actuator 292, is fixedly mounted to the base 210. Thus, the vertical extender 290 is pivotable at each of its two ends. This allows it to extend (upwardly) or retract (downwardly) the horizontal extender, regardless of the lateral position of the horizontal extender 250. It also allows it to controllably rotate the horizontal extender 250 about its pivot axis, which is defined by pivot assembly 230. In this way, as is shown in Figure 3A at M, the console may be radially positioned in front of the driver.

Figure 7 shows a pneumatic system 400 for feeding and controlling the horizontal and vertical actuators 250 and 290. An air pressure source 405 supplies air through a coalessing filter 410 to a regulator 415, which in the depicted embodiment is set at 125PSIG. Regulator 415 in concert with a drain 420 provide a regulated air source for driving horizontal and vertical actuators252 and 292, respectively. System 400 also includes vertical and horizontal solenoid valve assemblies 425 and 435, respectively. Each solenoid assembly includes first and second valves that may be opened by electrically driving associated solenoids. As shown in Figure 7, horizontal actuator 252 is extended when a signal is applied to a Ahorizontal expand≅ input of solenoid valve assembly 435. Alternatively, the actuator is retracted when a signal is applied to its horizontal retract input. Similarly, the vertical actuator 292 is expanded upwardly when a signal is applied to a Avertical up≅ input. With the depicted vertical solenoid valve assembly 425, a second solenoid valve is not used since gravitational forces will cause the vertical actuator 292 to retract when an activation signal is no longer applied to the Avertical up≅ input. With the pneumatic system 400, electrical signals from

the customer interface control system (which is addressed below) can control the positions of the horizontal and vertical expanders 250 and 290 and thus, the position of the console 310.

Figure 8 shows a block diagram 515 of one embodiment of a system for controlling the customer interface 200. System 500 includes system controller 520, which includes fan/heater 522, electrical boards unit 524, card cage 526, and logic board 528. These units are operably connected to one another to form the overall system controller 520. The card cage 526 includes an info screen, graphics processor unit, an audio/video board, a CPU board, and a power supply. The electrical boards unit 524 implements I/O functions. Among other things, it operably connects the CPU board of the card cage 526 to the various external devices (e.g., sensors, actuators) to be controlled or to provide information to or receive information therefrom.

These external devices include intruder detection 532, horizontal extension solenoid valve assembly 435 (Figure 7), vertical extender solenoid valve assembly 425 (Figure 7), horizontal extender position feedback 538 (which encompass sensors 273), vertical extender position feedback 540, lights (red/green) 554, 2X avoidance sensor 556, and customer console 310. The intruder detection 532 provides the CPU with an alert signal responsive to detecting an intruder (e.g., person, vehicle) in the refueling area so that it may halt automatic refueling. Horizontal and vertical extender position feedback sensors 338, 340 provide the CPU with position signals that correspond to the respective extensions (or positions) of the horizontal and vertical extenders 250 and 290. Based on this information, the CPU can control the position of console 310 by controlling the extender positions through solenoid valve assemblies 435 and 425. In accordance with a desired refueling program, the CPU activates

red or green lights 554 to instruct the vehicle driver to either stop or pull ahead. The CPU receives position information from the 2X avoidance sensor 256 to ensure that the console is not positioned too close to the vehicle. The system controller communicates with the console 310 to among other things provide it with appropriate video/audio information, operate its printer, receive vehicle/user information (e.g., from a card reader), and receive user commands (e.g., keypad, switches). A ballast 552 is also included for providing ballast information to the console 310. In the depicted embodiment, the fuel pump motor 544 is also controlled by the system controller 520.

In one embodiment, the components of the system controller 520 are housed in system control assemblies 220 and 225 of the customer interface 200. Suitable conventional components may be used to implement the system 515.

In accordance with one embodiment of the invention, the card reader, the buttons which are accessible by the customer, the printer, the display and the emergency halt switch appears on the customer console. The other electronic components are rearward in the system control module assemblies 220:225. This reduces the weight of the customer console. As a result of the reduction in weight of the customer console, vertical extender 290 may be used for vertically positioning the console 310 by rotating it as shown in Figure 3A at M. The amount of pivot is determined by the type of vehicle which has arrived at the station for robotic refueling. Thus, if a station wagon, SUV, pickup truck or the like is there, the customer console 310 would be rotated upwardly to a greater angle than would be the case if a small compact vehicle had arrived. As discussed earlier, the positioning of the console horizontally is accomplished with horizontal extender 250. The position of the front of the customer console with respect to the vehicle is designed to provide access to the console by

a customer but is restricted in horizontal movement in such a manner that it will not, in fact, contact the customers vehicle. This positioning in controlled by 2X sensors (e.g., acoustic sensors) which are positioned beneath the customer console. These sensors determine the position of the vehicle and then through the appropriate control in the CPU/electronic boards position the customer console in the horizontal position accordingly.

The input signals to the solenoids come from the electronic board as referred to above, and the horizontal solenoid valve 235 will apply air pressure to the extend port as desired. Otherwise, the pressure is normally applied to the retract port to keep the console 310 in its retracted position. It is also noted that the vertical extender 290 is normally in its retract position and will be extended or rotated upwardly when the vertical solenoid 425 is actuated to apply pressure to the extend port.

In one embodiment, the system may operates in conjunction with the use of a radio frequency identification device (e.g., transponder as above described) which is retained within the customers automobile. This device contains information regarding the vehicle insofar as the type of vehicle, the location of the fuel filler door and the like which is needed to accomplish the robotic refueling. As the customer approaches the station a transmitter sends a radio frequency signal to activate the ARFID≅ and it responds to provide information regarding the vehicle. If the customers vehicle is in fact approved, then the customer will receive a green light (as shown at 554) informing the customer to proceed. If the customer is not approved, then a red light will be displayed telling the customer to wait. When the customer drives forward and stops at the appropriate position, the customer console 310 is positioned as above described. Displayed also on the customer console are a pair of lights, one red and one green, which are used to instruct the customer to remain in position while the

refueling is occurring (red activated) and when such is completed, informing the customer that he may start the car and leave (green light activated).

It is desirable to have the customer stop the automobile in a position such that the fuel door position relative to the stowed position of the robot is somewhat fixed. In one embodiment of the present invention, this is accomplished by controllably moveably mounting the customer interface on a track (not shown). The entire unit may be controllably positioned (along the path of the incoming vehicle) to a predetermined position so that the customer console 310 is precisely positioned such that when the driver of the automobile stops with his window adjacent the face of the console, the fuel door for that particular automobile will be at the desired position relative to the refueling robot. This can be accomplished by having as part of the information on the RFID the distance from the center of the driver side window to the fuel door encoded. With that information, the entire customer interface assembly 200 can then be translated as above described to a position such that when the driver stops the vehicle adjacent the console, so that the driver can reach into and insert the credit card and punch the buttons, the fuel door will then be at this predetermined and desired position relative to the stowed robot.

By accomplishing this feature, the work area required for the robot to move from its stowed position to its refueling position may be drastically reduced. The movement of the base 210 to accomplish movement of the entire customer interface can easily be accomplished by utilizing a rotating screw or the like (in cooperation with the track to accomplish the overall movement while still maintaining structural integrity for the entire customer interface system. Although the present invention and its advantages have been described in detail, it should be understood that various changes, substitutions and alterations can be made herein

without departing from the spirit and scope of the invention as defined by the appended claims. Moreover, the scope of the present application is not intended to be limited to the particular embodiments of the process, machine, manufacture, composition of matter, means, methods and steps described in the specification. As one of ordinary skill in the art will readily appreciate from the disclosure of the present invention, processes, machines, manufacture, compositions of matter, means, methods, or steps, presently existing or later to be developed that perform substantially the same function or achieve substantially the same result as the corresponding embodiments described herein may be utilized according to the present invention. Accordingly, the appended claims are intended to include within their scope such processes, machines, manufacture, compositions of matter, means, methods, or steps.

WHAT IS CLAIMED IS:

1. A customer interface comprising:

(a) a base;

(b) a horizontal extender having first and second sections that are controllably extendable from one another, the first section being pivotally mounted to the base;

(c) a vertical extender having first and second sections that are controllably extendable from one another, the first section being pivotal with respect to the base, the second section being pivotally mounted to the second section of the horizontal extender; and

(d) a console mounted to the second section of the horizontal extender.

2. The customer interface of claim 1, wherein the first section of the vertical extender is mounted to the base.

3. The customer interface of claim 1, wherein the horizontal extender includes a pneumatic actuator.

4. The customer interface of claim 3, wherein the pneumatic actuator has at least an 18 inch stroke.

5. The customer interface of claim 3, wherein the horizontal extender includes a continuous position feedback sensor for providing a horizontal extension signal that indicates the distance that the horizontal extender is extended.

6. The customer interface of claim 3, wherein the horizontal extender comprises an arm assembly operably mounted to the pneumatic actuator.

7. The customer interface of claim 1 further comprising a system control assembly.

8. The customer interface of claim 7, wherein the system control assembly is mounted externally from the console.

9. The customer interface of claim 7, wherein the system control assembly comprises a system controller for controlling the customer interface.

10. The customer interface of claim 1, further comprising an RFID receiver for receiving a radio frequency identification signal from a vehicle to be refueled.

11. The customer console of claim 1, wherein the customer interface is controllably moveable along a path that is substantially parallel to a predetermined path of an incoming vehicle to be refueled.

12. A customer interface for a refueling system, the customer interface comprising:

(a) a horizontal extender having a first end and a controllably extendable second end, wherein the horizontal extender is pivotable at its first end;

(b) a console mounted to the controllably extendable end; and

(c) a vertical extender operably mounted to the horizontal extender between its first and second ends for vertically adjusting the horizontal extender, whereby the console is laterally extendable and radially positionable from its first end.

13. The customer interface of claim 12, wherein the first end is pivotally mounted to a base.

14. The customer interface of claim 13, wherein the base is longitudinally upright and has an upper end, wherein the horizontal extender is pivotally mounted to the upper end.

15. The customer interface of claim 12, wherein the vertical extender is pivotally mounted to the horizontal extender.

16. The customer interface of claim 15, wherein the vertical extender is pivotally mounted in a fixed position relative to the base.

17. The customer interface of claim 16, wherein the vertical extender is pivotally mounted to the base.

18. The customer interface of claim 12, wherein the horizontal extender comprises a pneumatic actuator.

19. The customer interface of claim 18, wherein the horizontal extender includes a continuous position feedback sensor for providing a horizontal extension signal that indicates the distance that the horizontal extender is extended.

20. The customer interface of claim 19, wherein the horizontal extender comprises an arm assembly operably mounted to the pneumatic actuator.

21. A method for positioning along a drive axis a driver-operated vehicle in an automatic refueling system that includes a customer interface and a refueling robot, comprising:

(a) receiving from the vehicle the distance between the driver and a fuel inlet on the vehicle; and

(b) positioning the customer interface along the drive axis so that when the driver is adjacent the customer interface the fuel inlet will be sufficiently proximal to the refueling robot.

Figure 1
PRIOR ART

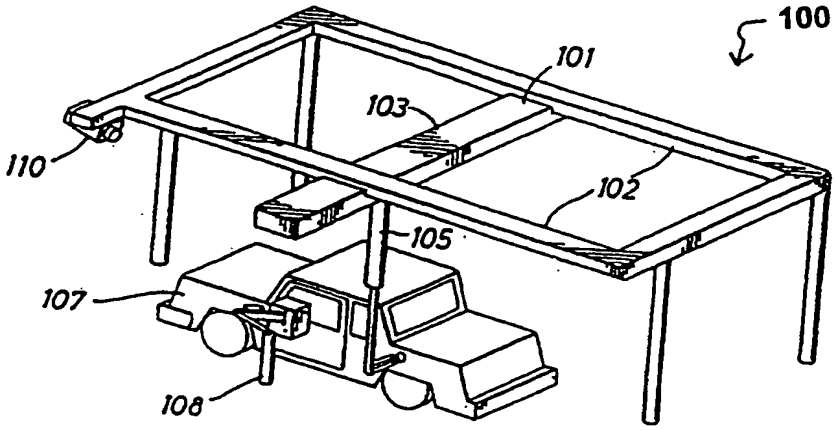


Figure 2

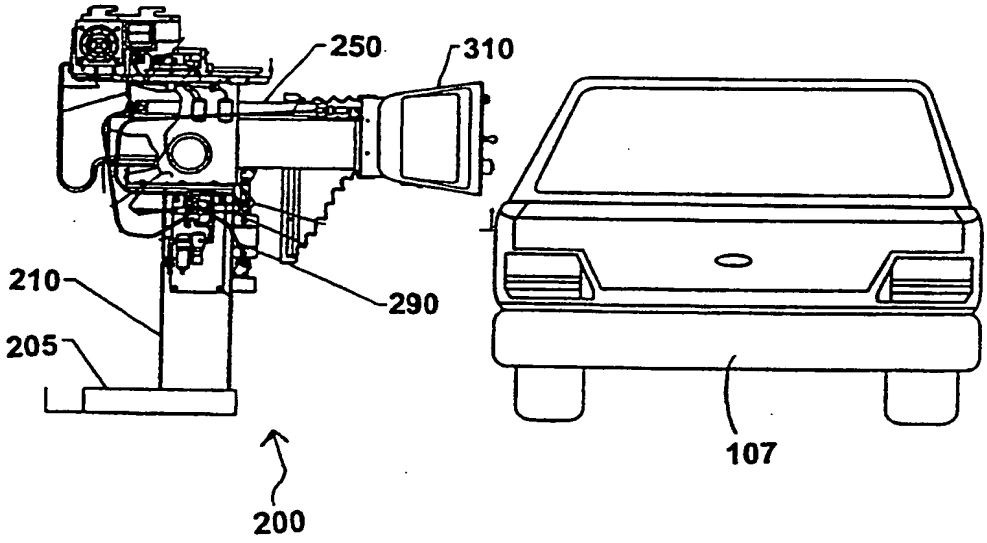


Figure 3A

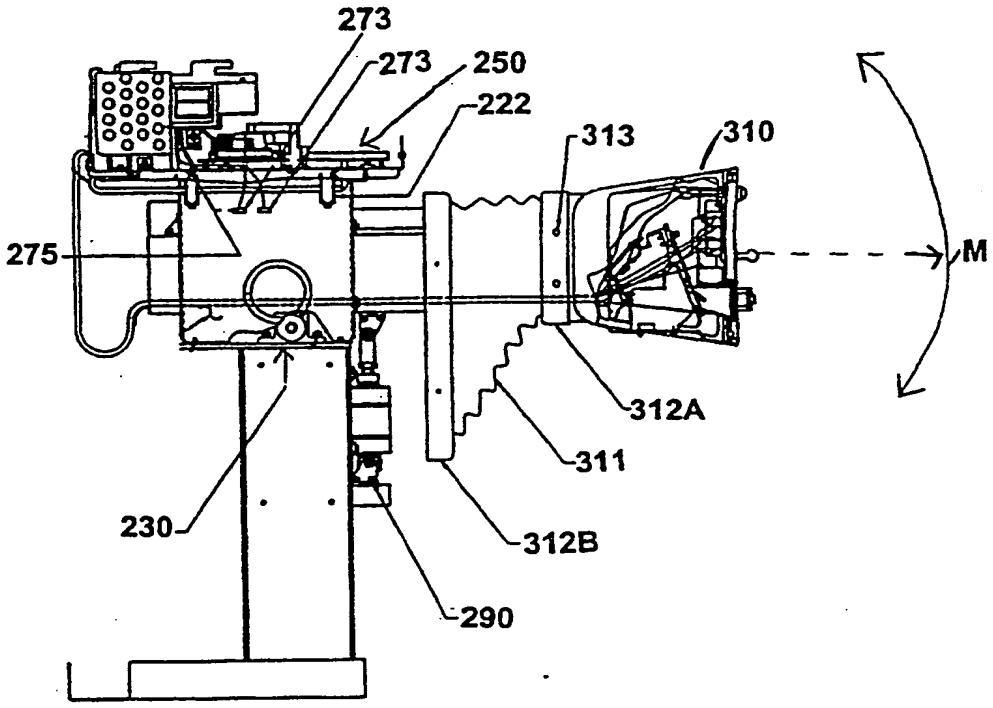
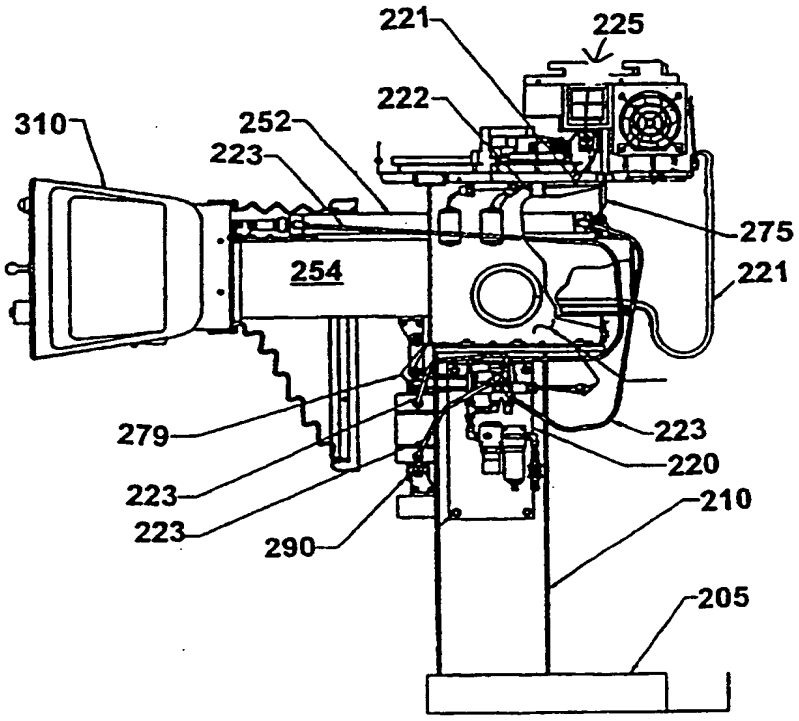


Figure 3B



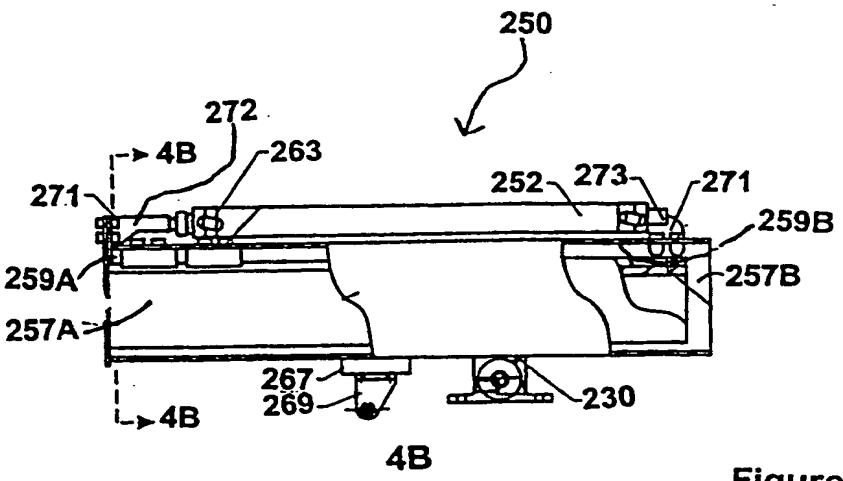


Figure 4A

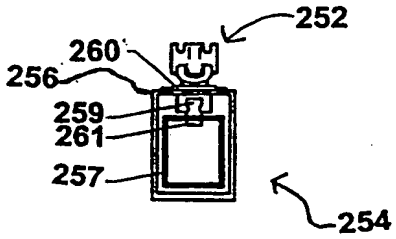


Figure 4B

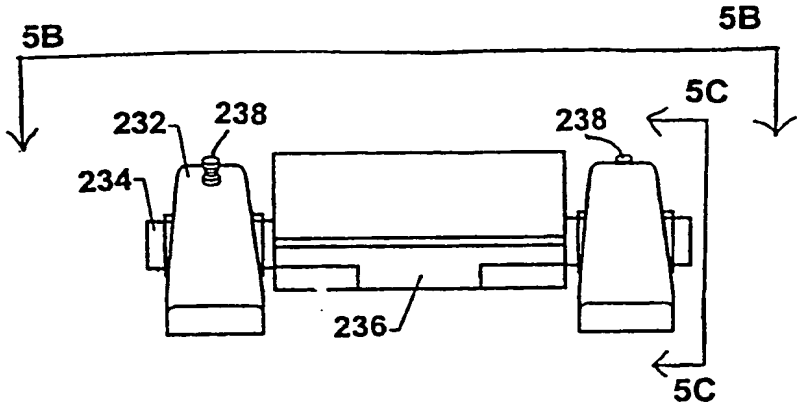


Figure 5A

250

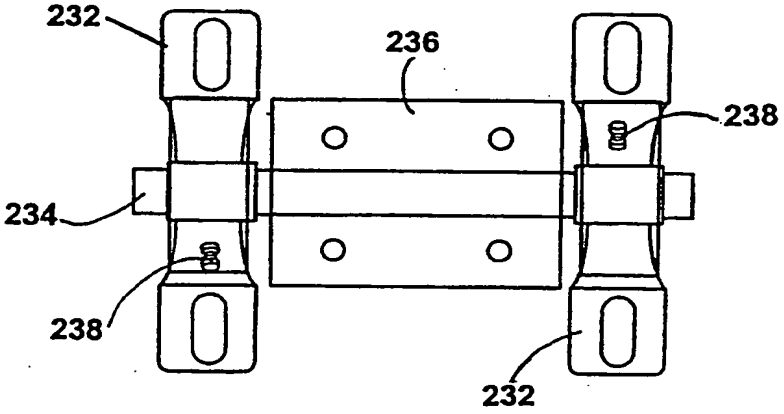


Figure 5B

230

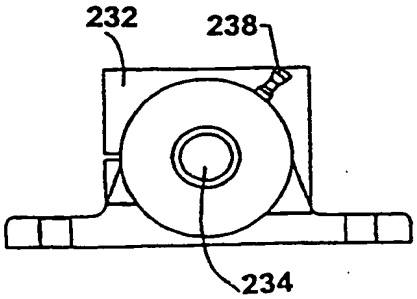


Figure 5C

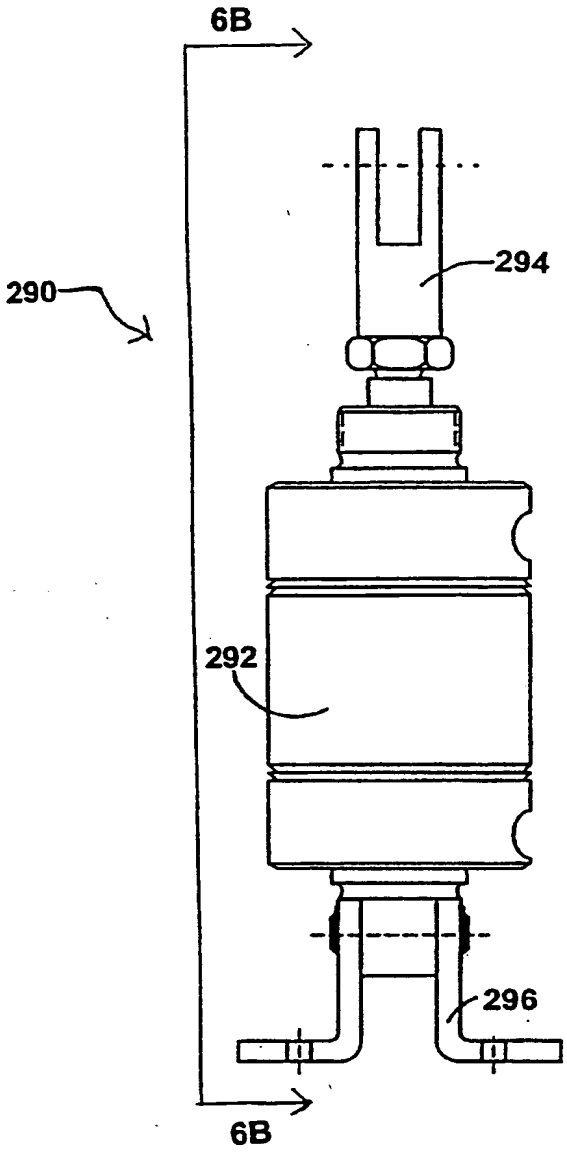


Figure 6A

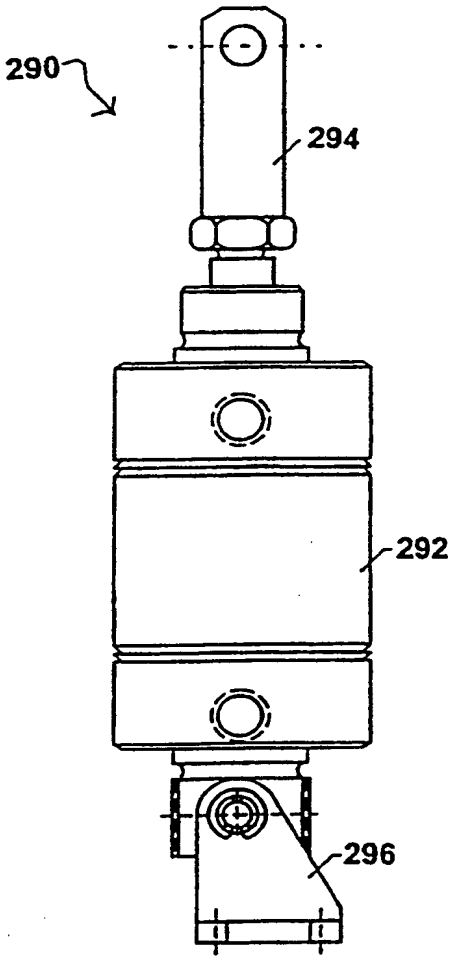


Figure 6B

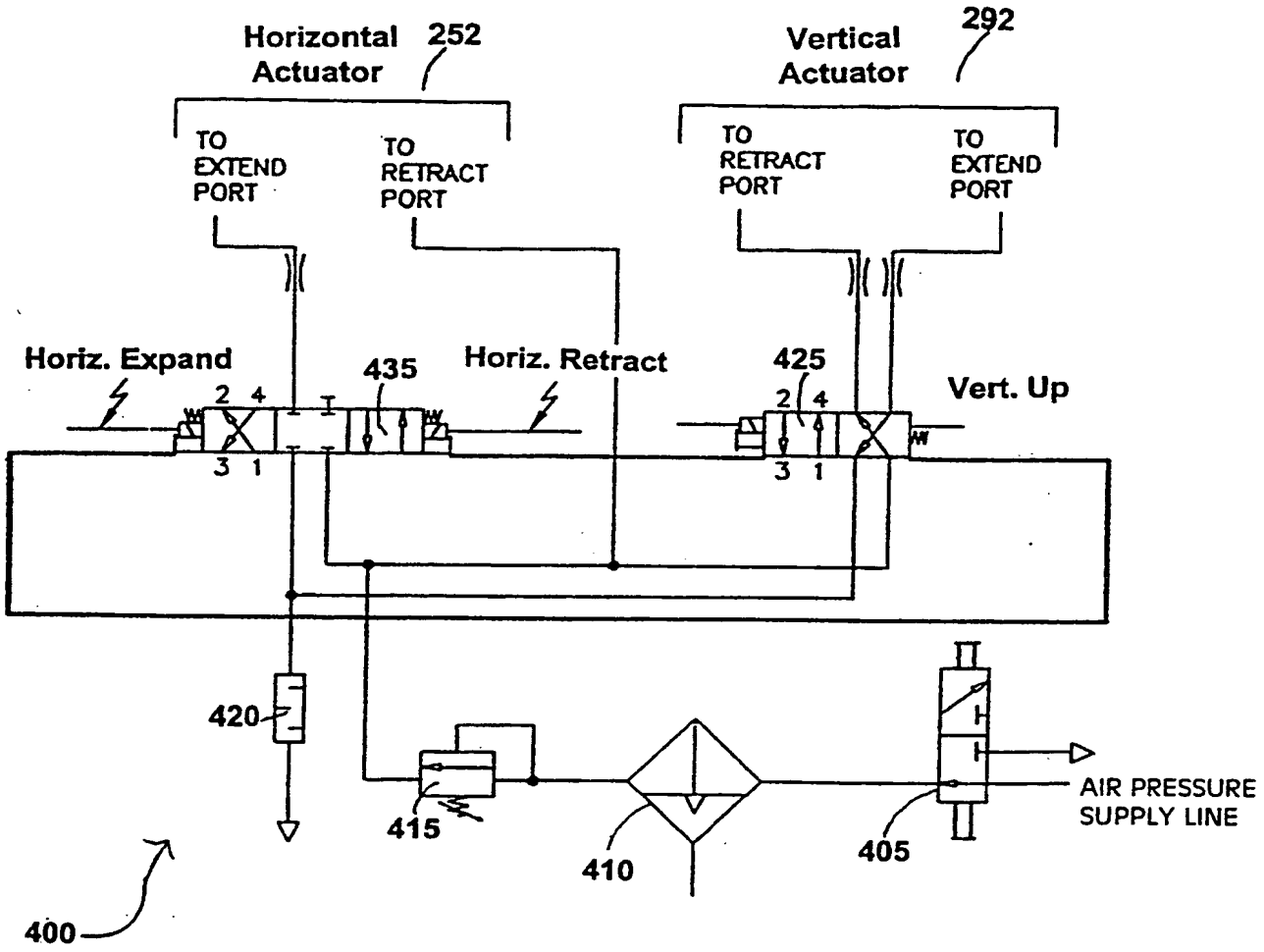


Figure 7

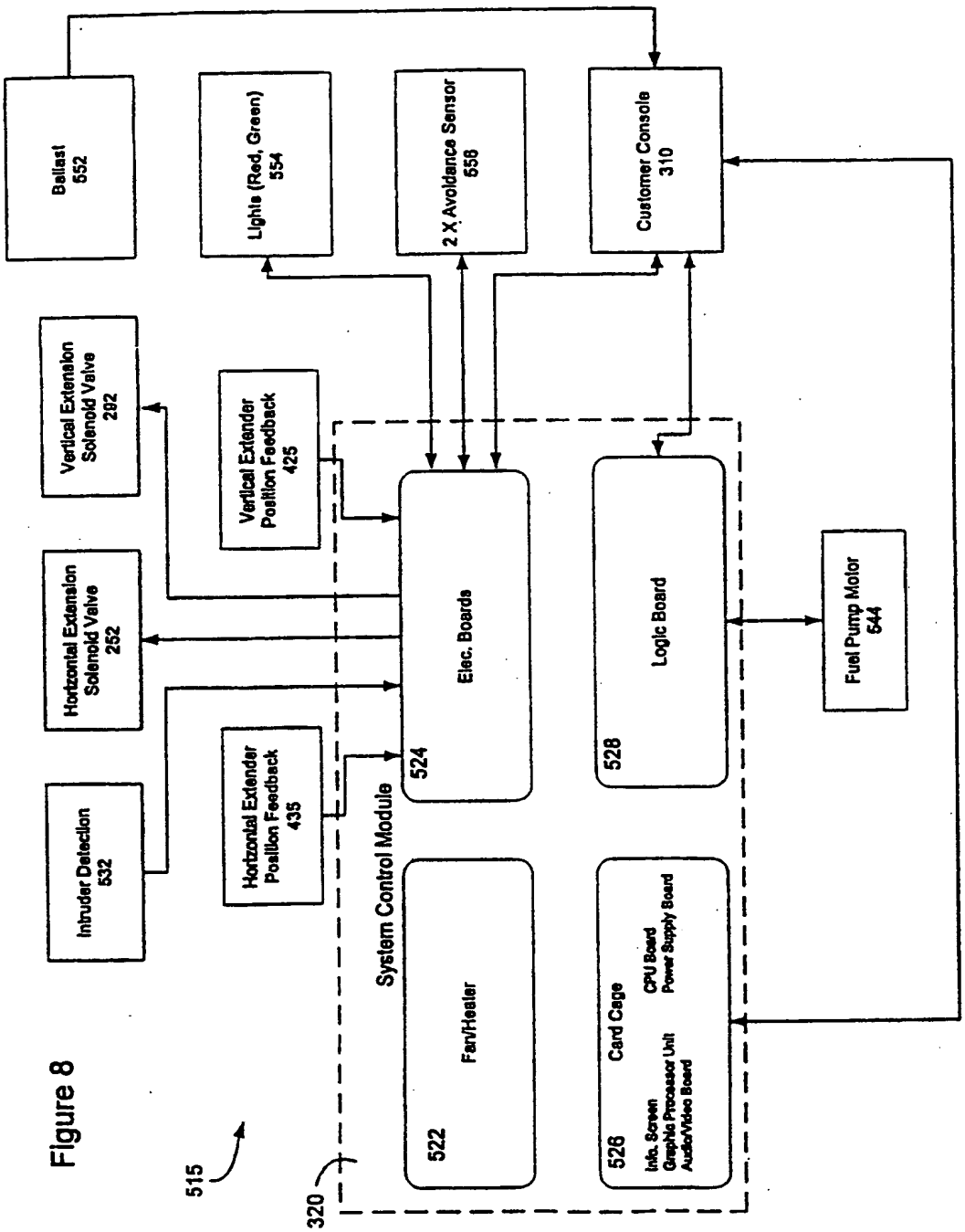


Figure 8

INTERNATIONAL SEARCH REPORT

Int tional Application No
PCT/US 00/32810

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B67D5/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B67D B25J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 735 289 A (KENYON ANTHONY) 5 April 1988 (1988-04-05)	21
A	abstract; figures 1-11	1,12
X	US 5 644 119 A (PADULA JOSEPH ANTHONY ET AL) 1 July 1997 (1997-07-01) cited in the application column 2, line 5 - line 17; figures 2,3	21
A	WO 95 32919 A (GUNNARSSON STAFFAN) 7 December 1995 (1995-12-07)	
A	DE 298 11 143 U (MARX CLAUDIUS DR) 1 October 1998 (1998-10-01)	
A	US 4 835 711 A (HUTCHINS BURLEIGH M ET AL) 30 May 1989 (1989-05-30)	

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search	Date of mailing of the international search report
21 March 2001	29/03/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Müller, C

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INTERNATIONAL SEARCH REPORT

Int tional Application No
PCT/US 00/32810

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	WO 94 03391 A (BRAZZELLI GIAN CARLO ;BOSCO GIAMMARIA (IT); CAMPIA VALTER (IT); AR) 17 February 1994 (1994-02-17)	

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INTERNATIONAL SEARCH REPORT

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Int .tional Application No
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